(Part-I)

2. Write short answers to any Six (6) questions: (12)

(i) If $B = \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}$, then verify that $(B^t)^t = B$.

Ans

$$B = \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}$$

$$B^t = \begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix}$$

$$(B^t)^t = \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix} = B$$

$$\therefore \quad (B^t)^t = B$$

(ii) If $\begin{bmatrix} a+3 & 4 \\ 6 & b-1 \end{bmatrix} = \begin{bmatrix} -3 & 4 \\ 6 & 2 \end{bmatrix}$, then find a, b.

Ans

$$\begin{bmatrix} a+3 & 4 \\ 6 & b-1 \end{bmatrix} = \begin{bmatrix} -3 & 4 \\ 6 & 2 \end{bmatrix}$$

$a + 3 = -3$ $b - 1 = 2$

$a = -3 - 3$ $b = 2 + 1$

$a = -6$ $b = 3$

(iii) Simplify: $5^{2^3} \div (5^2)^3$

Ans

$$= 5^{2^3} \div (5^2)^3$$

$$= 5^8 \div 5^6$$

$$= 5^{8-6}$$

$$= 5^2$$

$$\boxed{= 25}$$

(iv) Evaluate: i^{50}

Ans

$$(i)^{50}$$

$$= i^{48} \cdot i^2$$

$$= (i^4)^{12} \cdot i^2 \qquad \text{we know} \qquad i^2 = -1$$

$$= [(i^2)^2]^{12} \cdot i^2 \qquad\qquad\qquad\qquad i^4 = 1$$

$$= [(-1)^2]^{12} \times -1 = (1)^{12} \times -1$$

$$= 1 \times -1$$
$$= -1$$

(v) Find the value of x $\log_{625} 5 = \frac{1}{4} x$.

Ans $\log_{625} 5 = \frac{1}{4} x$

$$(625)^{1/4x} = 5$$
$$(5^4)^{1/4x} = 5^1 \qquad \therefore (a^m)^n = a^{mn}$$
$$5^x = 5^1$$
$$x = 1$$

(vi) Express the given number in scientific notation: 416.9

Ans
$$416.9 = 4.169 \times 100$$
$$= 4.169 \times 10^2$$

(vii) Simplify the given expression:
$$\frac{(x+y)^2 - 4xy}{(x-y)^2}$$

Ans $\dfrac{(x+y)^2 - 4xy}{(x-y)^2} = \dfrac{x^2 + y^2 + 2xy - 4xy}{x^2 + y^2 - 2xy}$

$$= \frac{x^2 + y^2 - 2xy}{x^2 + y^2 - 2xy} = 1$$

(viii) Simplify: $\sqrt{21} \times \sqrt{7} \times \sqrt{3}$

Ans $\sqrt{21} \times \sqrt{7} \times \sqrt{3} = \sqrt{21 \times 7 \times 3}$

$$= \sqrt{3 \times 7 \times 7 \times 3}$$
$$= \sqrt{3^2 \times 7^2}$$
$$= 3 \times 7$$
$$= 21$$

(ix) Factorize: $4x^2 - 16y^2$

Ans
$$4x^2 - 16y^2$$
$$= 4(x^2 - 4y^2)$$
$$= 4((x)^2 - (2y)^2)$$
$$\therefore a^2 - b^2 = (a+b)(a-b)$$
$$= 4(x + 2y)(x - 2y)$$

3. **Write short answers to any Six (6) questions:** (12)

(i) Find H.C.F: $102xy^2z$, $85x^2yz$, $187xyz^2$

Ans

Factorization of $102xy^2z = 2 \times 3 \times 17 \times x \times y \times y \times z$

// // // $85x^2yz = 5 \times 17 \times x \times x \times y \times z$

// // // $187xyz^2 = 11 \times 17 \times x \times y \times z \times z$

Common factors $= 17, x, y, z$

$$H.C.F = 17 \times x \times y \times z$$
$$= 17xyz$$

(ii) Solve the equation: $\sqrt{\dfrac{x+1}{2x+5}} = 2$, $x \neq -\dfrac{5}{2}$.

Ans

$$\sqrt{\frac{x+1}{2x+5}} = 2$$

or $$\left(\frac{x+1}{2x+5}\right)^{1/2} = 2$$

Squaring both sides,

$$\left(\left(\frac{x+1}{2x+5}\right)^{1/2}\right)^2 = (2)^2$$

$$\frac{x+1}{2x+5} = 4$$

Multiply by $2x+5$ on both sides,

$$x + 1 = 4 \times (2x + 5)$$
$$8x + 20 = x + 1$$
$$8x - x = 1 - 20$$
$$7x = -19$$
$$x = -\frac{19}{7}$$

(iii) Solve for x $|2x + 5| = 11$

Ans

$$+(2x + 5) = 11 \qquad \text{or} \qquad -(2x + 5) = 11$$
$$2x + 5 = 11 \qquad \text{or} \qquad 2x + 5 = -1$$
$$2x = 11 - 5 \qquad \text{or} \qquad 2x = -11 - 5$$
$$2x = 6 \quad \text{or} \qquad 2x = -16$$
$$x = 3 \qquad \text{or} \qquad x = -8$$

Therefore, 3, −8 are the solutions of the given equation.

or $S.S = \{3, -8\}$.

(iv) Writing in the form of $y = mx + c$ find the value of m and c: $x - 2y = -2$.

Ans
$$x - 2y = -2$$
$$-2y = -x - 2$$
$$\frac{-2y}{-2} = -\frac{x}{-2} - \frac{2}{-2}$$
$$y = \frac{1}{2}x + 1$$
$$y = mx + c$$

By comparison,
$$\Rightarrow \quad m = \frac{1}{2}, \, c = 1.$$

(v) Verify whether the point $(0, 0)$ lies on the line $2x - y + 1 = 0$ or not.

Ans
$$2x - y + 1 = 0$$
or
$$y = 2x + 1$$
Putting $x = 0$ and $y = 0$ in this equation
$$0 = 2(0) + 1$$
$$0 = +1$$
which is impossible.
Therefore $(0, 0)$ does not lie on the given line.

(vi) Find the mid-point of the line segment joining the pair of points $A(0, 0)$, $B(0, -5)$.

Ans
$$A = (0, 0) = (x_1, y_1)$$
$$B = (0, -5) = (x_2, y_2)$$
Let $M(x, y)$ is the mid-point
$$M(x, y) = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$
$$\therefore \quad M(x, y) = \left(\frac{0 + 0}{2}, \frac{0 + (-5)}{2} \right)$$
$$= (0, \frac{-5}{2}) \text{ is the required mid-point.}$$

(vii) Find the distance between the points:
$A(9, 2)$, $B(7, 2)$.

Ans The distance formula:
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

From the above points,

$x_1 = 9,\ x_2 = 7,\ y_1 = 2,\ y_2 = 2$
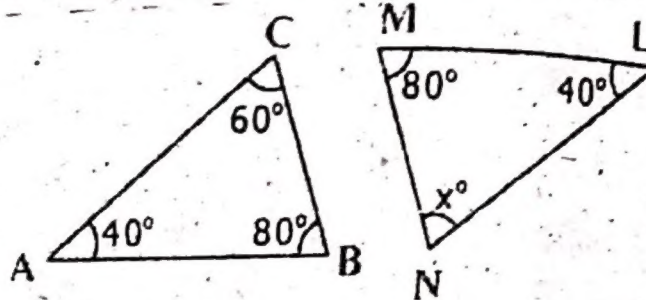
By putting the values in the distance formula,

$$d = \sqrt{(7-9)^2 + (2-2)^2}$$
$$= \sqrt{(-2)^2 + (0)^2}$$
$$= \sqrt{4}$$
$$d = 2$$

(viii) If $\triangle ABC \cong \triangle LMN$, find the value of x:

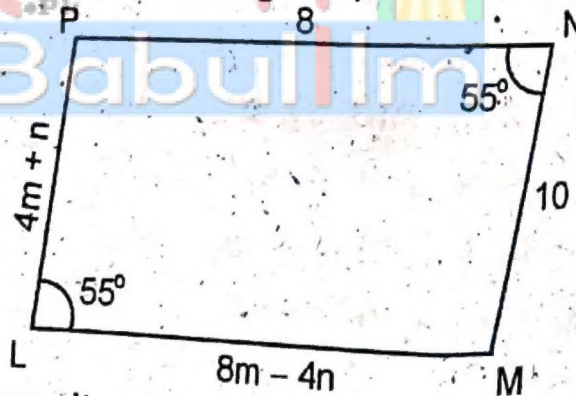**Ans** As $\triangle ABC \cong \triangle LMN$

$m\angle A = m\angle L = 40^\circ$ and

$m\angle B = m\angle M = 80^\circ$ and

$m\angle N = m\angle C$

So, $x^\circ = 60^\circ$

(ix) If LMNP is a parallelogram, find the values of m, n:

Ans From opposite sides of ‖ gram

$4m + n = 10$ (1)

$8m - 4n = 8$ (2)

Multiplying eq. (1) by '4' and adding in eq. (2),

$16m + 4n = 40$

$8m - 4n = 8$

————————————

$24m \qquad = 48$

$$m = \frac{48}{24}$$

$$\boxed{m = 2}$$

By putting m = 2 in eq. (1), we get

$$4(2) + n = 10$$
$$8 + n = 10$$
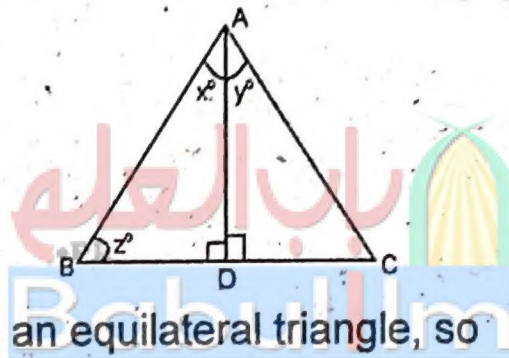$$n = 10 - 8$$
$$\boxed{n = 2}$$

4. **Write short answers to any Six (6) questions: (12)**

(i) Define ratio.

Ans Comparison of two similar type of quantities having same units of quantities and same units is called ratio. It is expressed as; a : b or $\frac{a}{b}$. For example, 2 : 3.

(ii) In equilateral triangle ABC, $\overline{AD}$ is bisector of angle A, then find the value of x°, y° and z°:

Ans As ABC is an equilateral triangle, so

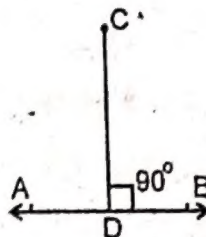$$\angle A = \angle B = \angle C = 60°$$
$$x° = y° = \frac{60°}{2} = 30°$$

From figure z° = C°
But   C = 60°
So,   z° = 60° and x° = 30°, y° = 30°

(iii) What will be the angle for shortest distance from an outside point to the line?

Ans

As the shortest distance from a point outside to a line is the perpendicular distance. So the angle is 90°.

(iv) Verify that the Δ having the measure of sides is right angled:

$$a = 5 \text{ cm}, \ b = 12 \text{ cm}, \ c = 13 \text{ cm}$$

Ans By Pythagoras theorem,

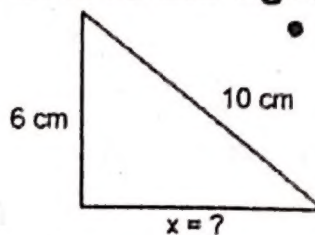$$(\text{Hypotenuse})^2 = (\text{Perpendicular})^2 + (\text{Base})^2$$
$$(13)^2 = 5^2 + 12^2$$
$$169 = 25 + 144$$
$$169 = 169$$

Hence verified.

(v) Find the value of x in the figure:

6 cm, 10 cm, x = ?

Ans As
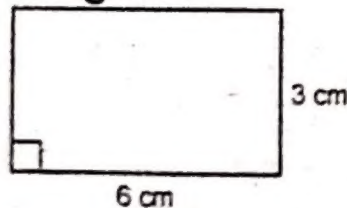$$(\text{Hyp})^2 = (\text{Base})^2 + (\text{Perp})^2$$
$$(10)^2 = (x)^2 + (6)^2$$
$$100 = x^2 + 36$$
$$100 - 36 = x^2$$
$$\Rightarrow \quad x^2 = 64$$
$$x = 8 \text{ cm}$$

(vi) Find the area of figure:

3 cm, 6 cm

Ans Length of rectangle = 6 cm = l
Width of // // = 3 cm = w
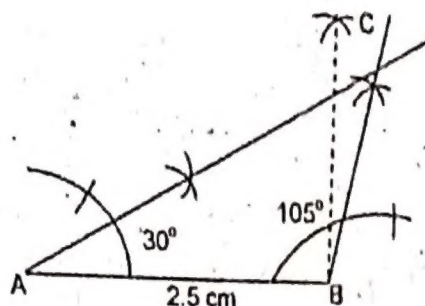Area = $l \times w$
w = Area of // // = 6×3
$$= 18 \text{ cm}^2$$

(vii) Define area of the figure.

Ans The region enclosed by the boundary of the closed figure is called area of a figure.

(viii) Construct $\triangle ABC$ in which: $m\overline{AB} = 2.5$ cm, $m\angle A = 30°$, $m\angle B = 105°$.

Ans

$\triangle ABC$ is the required triangle.

(ix) Define circumcentre.

Ans The point of concurrency of the perpendicular bisectors of the sides of a triangle is called its circumcenter.

(Part-II)

NOTE: Attempt THREE (3) questions in all. But question No. 9 is Compulsory.

Q.5.(a) Solve the system of linear equations by using Cramer's rule: (4)

$$2x - 2y = 4$$
$$3x + 2y = 6$$

Ans For Answer see Paper 2017 (Group-I), Q.5.(a).

(b) Simplify: $\left(\dfrac{a^p}{a^q}\right)^{p+q} \cdot \left(\dfrac{a^q}{a^r}\right)^{q+r} \div 5(a^p \cdot a^r)^{p-r}$, $a \neq 0$. (4)

Ans
$$\left(\frac{a^p}{a^q}\right)^{p+q} \cdot \left(\frac{a^q}{a^r}\right)^{q+r} \div 5(a^p \cdot a^r)^{p-r}$$

$$= \frac{(a^{p-q})^{p+q} \cdot (a^{q-r})^{q+r}}{5(a^{p+r})^{p-r}}$$

$$= \frac{a^{(p-q)(p+q)} \cdot a^{(q-r)(q+r)}}{5 \cdot a^{(p+r)(p-r)}}$$

Using $(a-b)(a+b) = a^2 - b^2$

$$= \frac{a^{p^2-q^2} \cdot a^{q^2-r^2}}{5a^{p^2-r^2}}$$

$$= \frac{1}{5} a^{p^2-q^2+q^2-r^2-p^2+r^2}$$

$$= \frac{1}{5} a^0 \qquad\qquad \therefore \qquad a^0 = 1$$

$$= \frac{1}{5} \times 1$$

$$= \frac{1}{5}$$

Q.6.(a) Use log table to find the value of : $\sqrt[3]{25.47}$. **(4)**

Ans $\sqrt[3]{25.47}$

Let $\quad x = \sqrt[3]{25.47}$

$\qquad = (25.47)^{1/3}$

Applying log on both sides,

$\log x = \log (25.47)^{1/3}$

$\qquad = \frac{1}{3} \log (25.47)$

$\qquad = \frac{1}{3} (1.4060)$

$\log x = 0.4687$

Taking Antilog,

$x = $ Antilog 0.4687

$\qquad = 2.942$

So, $\quad \sqrt[3]{25.47} = 2.942$

(b) If $x + y + z = 12$ and $x^2 + y^2 + z^2 = 64$, then find the value of $xy + yz + zx$. **(4)**

Ans For Answer see Paper 2018 (Group-I), Q.6.(b).

Q.7.(a) Factorize: $x^2 - y^2 - 4xz + 4z^2$ **(4)**

Ans $\qquad x^2 - y^2 - 4xz + 4z^2$

Re-arranging

$\qquad x^2 - 4xz + 4z^2 - y^2$

$= [x^2 - 2(x)(2z) + (2z)^2] - y^2$

$\qquad\qquad\qquad \therefore \quad a^2 - 2ab + b^2 = (a - b)^2$

$= (x - 2z)^2 - (y)^2$

$$\therefore a^2 - b^2 = (a+b)(a-b)$$
$$= (x - 2z + y)(x - 2z - y)$$
$$= (x + y - 2z)(x - y - 2z)$$

b) Find the H.C.F. by the division method: (4)
$$x^3 + 3x^2 - 16x + 12, \quad x^3 + x^2 - 10x + 8$$

Ans

$$
x^3 + x^2 - 10x + 8
\begin{array}{r}
1 \\
\hline
x^3 + 3x^2 - 16x + 12 \\
\pm x^3 \pm x^2 \mp 10x \pm 8 \\
\hline
2x^2 - 6x + 4 \\
x^2 - 3x + 2
\end{array}
$$

$$
x^2 - 3x + 2
\begin{array}{r}
x + 4 \\
\hline
x^3 + x^2 - 10x + 8 \\
\pm x^3 \mp 3x^2 \pm 2x \\
\hline
4x^2 - 12x + 8 \\
\pm 4x^2 \pm 12x \pm 8 \\
\hline
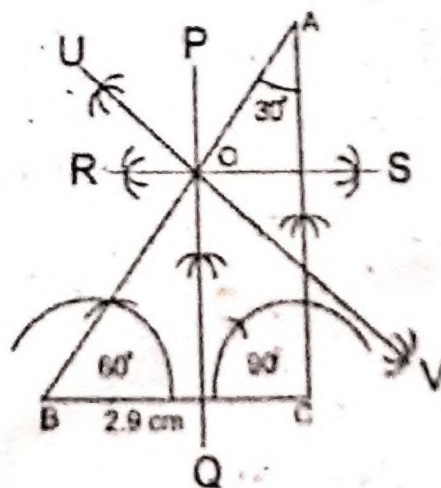x
\end{array}
$$

H.C.F $= x^2 - 3x + 2$

Q.8.(a) Solve the equation: $\dfrac{5(x-3)}{6} - x = 1 - \dfrac{x}{9}$. (4)

Ans For Answer see Paper 2017 (Group-II), Q.8.(a).

b) Construct the △ABC and draw the perpendicular bisectors of its sides: (4)

$$m\overline{BC} = 2.9 \text{ cm}, \ m\angle A = 30°, \ m\angle B = 60°$$

Ans

Steps of Construction:

1. Take a line segment $m\overline{BC} = 2.9$ cm.
2. Draw an angle $\angle CBW = 60$ at B.
3. We find $m\angle C$ first and draw

$$m\angle C = 180 - m\angle B - m\angle A$$
$$= 180 - 60 - 30$$
$$= 90°$$

4. Draw an angle $\angle C = 90°$ at point C.
5. Which intersects $m\angle B$ at A.
6. ABC is a required Δ.
7. $\overleftrightarrow{RS}$, $\overleftrightarrow{UV}$ and $\overleftrightarrow{PQ}$ are the right bisectors of $\overline{AC}$, $\overline{AB}$ and $\overline{BC}$, respectively.
8. $\overrightarrow{PQ}$, $\overleftrightarrow{RS}$ and $\overleftrightarrow{UV}$ are concurrent at point O.

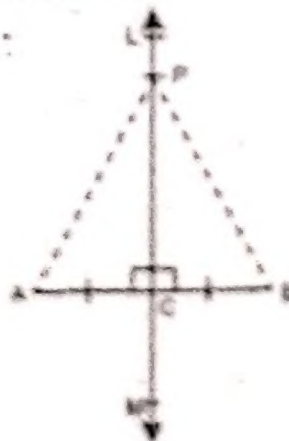**Q.9.** Prove that any point on the right bisector of a line segment is equidistant from its end points. **(8)**

Ans.

Given:

A line LM intersects the line segment AB at the point C such that $\overleftrightarrow{LM} \perp \overline{AB}$ and $\overline{AC} \cong \overline{BC}$. P is a point on $\overleftrightarrow{LM}$.

To Prove:

$$\overline{PA} \cong \overline{PB}$$

Construction:

Join P to the points A and B.

Proof:

Statements	Reasons
In $\triangle ACP \leftrightarrow \triangle BCP$	
$\overline{AC} \cong \overline{BC}$	given
$\angle ACP \cong \angle BCP$	given $\overline{PC} \perp \overline{AB}$, so that each $\angle$ at C = 90°
$\overline{PC} \cong \overline{PC}$	common
$\therefore \triangle ACP \cong \triangle BCP$	S.A.S. postulate
Hence $\overline{PA} \cong \overline{PB}$	(corresponding sides of congruent triangles)

OR

Prove that any point on the bisector of an angle is equidistant from its arms.

Ans For Answer see Paper 2016 (Group-I) Q.9.